SCIENCE NEWS-LETTER

The Weekly Summary of Current Science

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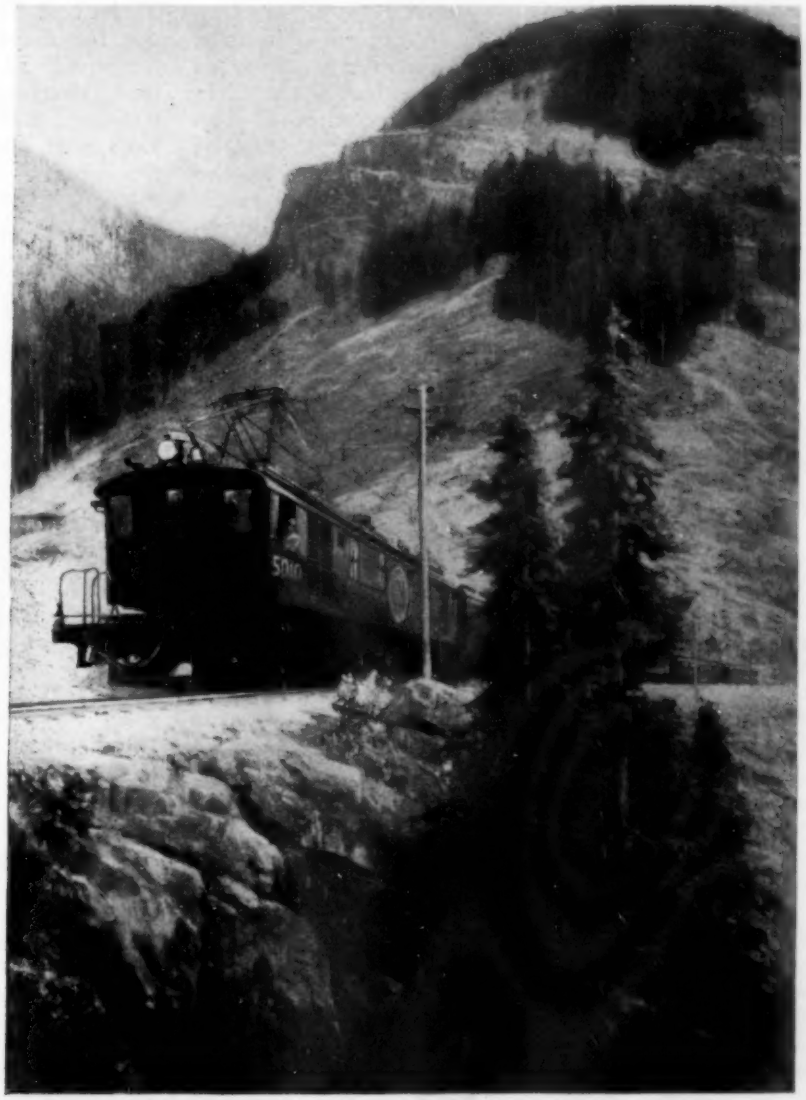

WHITE COAL FOR THE IRON HORSE

Western Trains Now Climb by Waterfall Power

(*See page* 140)

Vol. XIV *No. 887*

Iron Wire Acts Like Nerve

Physiology

A striking similarity between nervous action, particularly heart action, and the behavior of iron wire in a nitric acid bath has been discovered and studied by Ralph S. Lillie, professor of physiology at the University of Chicago.

According to A. J. Carlson, chairman of the department of physiology at the University of Chicago, the study of this similarity is of fundamental importance in the acquisition of knowledge concerning nervous action. "The obscure problems of physiology," said Dr. Carlson, "and the problems difficult to work out on experimental animals must be approached through study on easily controllable materials. The work of Dr. Lillie on the iron wire, because it yields results so similar to the observable phenomena in living nerves, is highly suggestive with reference to further research and ultimate knowledge." A popular demonstration of the experiment consists of a pure iron wire, 1 to 5 centimeters long, immersed in a bath of nitric acid of 60 to 80 per cent. A colorless film immediately forms over the wire. If the wire is scratched at one end, a wave travels rapidly along the wire. If a small glass tube is placed in the acid around one end of the wire, rhythmical waves pass the length of the wire at a rate of from 14 to 120 times a minute, depending on the strength of the solution, the temperature, and the length of the wire.

What happens, according to Dr. Lillie, is that a sort of battery is formed. The film, which is the thickness of only one molecule, has an electrical charge negative to that of the wire. When the film is scratched a current sets up which dissolves the film next to the bare spot. This continues until the bare spot, which is seen as a wave, has passed the length of the wire. The film forms again after the wave has passed. The glass ring at one end of the wire establishes an area of permanent activity because the acid becomes less concentrated. Thus, as if the film were being continually scratched, rhythmical waves pass along the wire as rapidly as the film is re-formed. "The process may be regarded," says Dr. Lillie, "as a two-dimensional explosion."

The analogy to nervous action is emphasized by the effect which outside factors have upon the rhythm of the wire. The influence of temperature, electrical polarization, concentration of acid and length of the wire, have been shown by Dr. Lillie to be the same as the influence of these factors on living nerves.

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White Coal for Iron Horse

Electricity

Whoever has seen the glories of the Rocky Mountains from an open observation car on the back of a steam locomotive drawn train realizes that a mouthful of smoke and cinders does not aid the enjoyment of the scenery. But such a state of affairs is passing. Electric locomotives are already replacing steam ones on some of the Western railroads, one of which is shown on the cover of this issue of the SCIENCE NEWS-LETTER. It depicts the Oriental limited of the Great Northern Railroad climbing through the Cascades in the state of Washington. The picture is from a painting made for the General Electric Company by Walter L. Greene, whose paintings of the aircraft carrier Saratoga, and of an airport at night, have previously appeared on our cover.

With the electric locomotive smoke and cinders are a thing of the past. One can even remain on the observation platform when passing through a tunnel, watching the spot light of the opening as it rapidly decreases and, if the tunnel is long enough, finally vanishes.

One economic advantage of the electric locomotive is that descending trains help pull others, even though they may be miles away. The motors act as generators when coasting, and actually feed current into the lines, instead of taking it out.

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In This Issue—

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Helen Keller Shows Future of Brain

Psychology

By Emily C. Davis

Ever since she was a little child, Helen Keller—going about life blind and deaf, but happy and sure of herself—has been an inspiration to handicapped men and women. She has been called the most remarkable woman of the century, and it would be difficult to think of any one to compete with her for the title.

Now Miss Keller has been given a significant role to play in the unfolding of man's development. Her senses, particularly those of touch and smell, have been studied by Dr. Frederick Tilney, professor of neurology at Columbia University. And, after observing the use that she has made of these senses, he concludes that the average normal person has developed his brain just about 20 per cent.

The 20 per cent. is a matter of simple arithmetic, Dr. Tilney shows. We have five primary senses which keep us posted as to the world around us—hearing, seeing, touch, taste, and smell. A human being who developed these five senses to their limit would be rated 100 per cent.

Helen Keller, depending almost entirely on the sense of touch to guide her, uses that sense to practically its full possibility. Her adjustment to life with this one sense is entirely adequate. She went through college, writes books in beautiful English, enjoys flowers, music, and conversation, and has as happy a philosophy as any one of our day. And because of all this Dr. Tilney believes that it is fair to say that Helen Keller's development with her one really useful sense equals the average person's development of his contact senses, even though he has five of them.

So, to finish the arithmetic problem, our brains are used to just about one-fifth of their possible capacity.

To understand how Miss Keller's example is a challenge, not alone to handicapped people, but to any normal person, you must follow some of Dr. Tilney's experiments. His problem was to measure the sensitiveness of skin, nerve, and muscle in an unusual human being, and to compare the measurements with the sensitiveness of other human beings. The measurements were so delicate that most of the scales had to be read in millimeters. Before some of the experiments could be conducted it was necessary to devise special apparatus.

HELEN KELLER shows how fingers can be used to feel the music of the radio. She knows gay melodies from sad ones by the difference in the vibrations

One of the specially constructed pieces of equipment was used in testing Miss Keller's sense of touch in respect to motion of the arm, hand or finger. Any one knows when his hand is being moved up and down. But what is the least movement of the hand or finger or wrist that can be felt? Dr. Tilney placed Miss Keller's hand on a flat board surface and raised or lowered it by a worm screw which measured the number of millimeters that the board was being lifted or dropped. Miss Keller recognized a rise of two millimeters and a drop of three.

Now, two millimeters translated into inches is roughly about one-twelfth of an inch. But if you are about to exclaim at the superior sensitiveness of Helen Keller's hands, wait.

Dr. Tilney also measured a number of people with normal senses, people who would be hard put to it to fumble for an electric light button in the dark. He found that Miss Keller's long practiced hands were not quite so sensitive to motion as those of the average person. She made a better record than some, but not so good as others.

Yet, consider this: Miss Keller, with her delicacy of touch rated scientifically as just barely average, walked in a garden with the nerve specialist and named every flower that he picked merely (*Turn to next page*)

Helen Keller Shows Future of Brain—*Continued*

by feeling its petals and leaves.

In another test of touch, the neurologist took a compass and separated the two points just a little and touched the points lightly to Helen Keller's hand. The object was to find the least distance apart that the compass points could be placed at which she could still feel the pressure of two separate points, instead of only one.

When another famous blind and deaf girl, Laura Bridgman, was tested in this way by Dr. Stanley Hall some years ago, the psychologist reported that she could discriminate two points so close together that the average person would think them only a single touch. But in the case of Helen Keller, it was found that her sensitiveness is just about normal. These tests of skin sensitiveness were made not only on the back of the hand, but also on the arm, chin, cheek, finger, and other points. In each test there was no sign of abnormal delicacy of the skin or nerve endings under the skin.

Dr. Tilney tested Miss Keller's sense of temperature with thermaphores. In this test an instrument heated to 100 degrees and another heated to 98½ degrees were placed on the skin for four seconds, and the subject of the experiment was asked whether the feeling was hot or cold. Miss Keller's average of right answers was about what the normal person would achieve. He tested her sense of pressure with special torsion springs and the least amount of pressure she could feel was again no more than you or I would have reported under such a test.

The result of it all is a mass of evidence that loss of sight and hearing has brought no greater sensitiveness to the fingers of this woman. Yet she holds her finger tips to the throat and lips of another person and feels words with them with remarkable facility. She can put a needle to her tongue and find the eye by touch and then by patient application fit a thread into that tiny eye. She went through Radcliffe College with honors, literally feeling her way through the lectures in the classroom, as her own teacher, Miss Anne Sullivan, spelled the professors' words into her hand with sign language.

The sense of smell is not so useful as touch, either to the blind person or to one with all his senses intact, but it adds greatly to the enjoyment and understanding of the world, as Miss Keller's experiences show.

On one occasion Dr. Tilney drove with Miss Keller from New York to her publisher's office in Garden City. They conversed as usual, Dr. Tilney spelling his questions into her hand by tapping out the letters with his fingers, as Miss Keller herself taught him to do, and Miss Keller answering aloud.

As the car sped along, the neurologist spelled out the question:

"How much does the sense of smell mean to you?"

She replied that she had called this sense the fallen angel, because its possibilities as a means of enjoyment are so much neglected and even scorned.

"It is a beautiful sense," she said. "It is my scenery. It tells me where I am and the character of my surroundings."

"Miss Helen," said the neurologist, "I am going to ask you to use your sense of smell to tell me what we are passing now."

She answered immediately: "We are going through open country."

And Dr. Tilney noted that they were passing a golf course.

Then she remarked that they were passing a grove of trees, which was true.

Then, she said that they had just passed a house with an open fire burning, and the professor looked back and saw a cottage with smoke coming out of the chimney.

Next, she said: "We are passing many buildings." And Dr. Tilney, surprised, observed that they were indeed going past an institution for the insane.

Finally, she announced: "We are now in Garden City," and the professor, still more surprised, asked how in the world she could tell him that.

"I smell the ink of the presses," Miss Keller answered.

Discussing this subject in one of her books, Miss Keller wrote:

"Out of doors I am aware by smell and touch of the ground we tread and the places we pass. Sometimes, when there is no wind, the odors are so grouped that I know the character of the country, and can place a hayfield, a country store, a garden, a barn, a grove of pines, a farmhouse with the windows open."

She also wrote: "From exhalations I learn much about people. I often know the work they are engaged in. The odors of wood, iron, paint, and drugs cling to the garments of those that work in them. Thus I can distinguish the carpenter from the ironworker, the artist from the mason or the chemist. When a person passes quickly from one place to another, I get a scent impression of where he has been—the kitchen, the garden, or the sick-room. I gain pleasurable ideas of freshness and good taste from the odors of soap, toilet water, clean garments, woolen and silk stuffs, and gloves.

"I have not, indeed, the all-knowing scent of the hound or the wild animal. None but the halt and the blind need fear my skill in pursuit; for there are other things besides water, stale trails, confusing cross tracks to put me at fault. Nevertheless, human odors are as varied and capable of recognition as hands and faces. The dear odors of those I love are so definite, so unmistakable, that nothing can quite obliterate them. If many years should elapse before I saw an intimate friend again, I think I should recognize his odor instantly in the heart of Africa, as promptly as would my brother that barks.

"Sometimes I meet one who lacks a distinctive person-scent, and I seldom find such a one lively or entertaining. On the other hand, one who has a pungent odor often possesses great vitality, energy and vigor of mind."

Most people are "smell blind and deaf", according to this woman who shows how useful the sense of smell can be, and when we hear her suggest this idea, we immediately jump to the conclusion that probably we are not to be blamed for poor use of our noses. Perhaps we have not the delicate nerve mechanism for appreciating the fine distinctions of scent as she has.

If we do offer this excuse, it is groundless.

To measure the sensitiveness of Helen Keller's olfactory nerves, Dr. Tilney prepared oils, such as wintergreen and asafetida, in various dilutions and asked her to tell him when she could notice any difference between the various odors. The weakest dilution of alcohol that she could smell was one part in 16. She detected eucalyptus as weak as one part in 64, wintergreen one part in 128, peppermint one part in 1,024, and asafeida one part in 2,048. And this is about the sensitiveness of the average person's smelling equipment.

After testing her sense of direction, the nerve specialist declared that Miss Keller has no feeling of direction at all. (*Turn to page* 147)

Rheumatic Fever and Teeth

Medicine

A medical progress note prepared by the American Association for Medical Progress.

The report of some recent studies of rheumatic fever by Drs. Swift, Derick and Hitchcock of New York suggests a new significance for the observed relation between this disease and the "focal infections" often associated with it. Infections of the teeth, tonsils, and other localized areas have hitherto been thought of as breeding places for specific disease germs, and as foci from which the germs are disseminated throughout the body by gaining access to the blood stream. Considerable evidence has accumulated, however, to show that in rheumatic fever there is a hyper-sensitive state which is not specific to one particular strain of bacteria. This hyper-sensitivenesss may be produced experimentally by the production of focal lesions (localized areas of infection) where injection of the characteristic germs directly into the blood does not produce it. The foci may be areas in which the substance responsible for the hypersensitive state is produced, and from which it is distributed to other tissues. Possibly the characteristic feature of the disease may be the state of the tissues rather than the specificity of the bacteria.

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Sleeping Sickness

Medicine

A medical progress note prepared by the American Association for Medical Progress.

A recent study by J. R. Perdrau of the National Institute for Medical Research, London, confirms an earlier statement that changes in the bodily tissue caused by post-vaccinal encephalitis, a rare disease about which there has recently been some newspaper discussion, can be distinguished under the misroscope as different from those caused by encephalitis lethargica, or ordinary sleeping sickness. From the literature it also appears to the author that the nervous disorders sometimes complicating smallpox, measles, and other fevers, as well as those occurring in the course of antirabic inoculation, are identical with the post-vaccination variety of encephalitis. His suggestion is that there may be a common agent for all of these complications, as well as for the disease known as acute disseminated sclerosis, which produces similar conditions.

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Research Hits "Fletcherizing"

Physiology

"Fletcherizing" decreases muscular endurance, typewriting accuracy, and basal metabolism. It has no significant effect on blood pressure, pulse, temperature, sleeping time, mental multiplication, and typewriting speed but increases efficiency in solving chess problems.

The results of a five year experiment on his own food consumption and human efficiency furnished Harald G. O. Holck, graduate student in physiology at the University of Chicago, with material for his thesis toward the Ph. D. degree. The long period included a year and a half of "Fletcherizing," two and a half years of "control" period before the "Fletcherizing," and half a year control period afterwards. According to A. J. Carlson, professor of physiology at the University and an authority on the physiology of food, this experiment, with its long control periods, is a most valuable contribution to the subject.

During the whole period of five years, Mr. Holck has kept detailed record of food and water intake, material eliminated, body weight, blood pressure and pulse rate, and basal metabolism or the rate of energy consumption. Physiological efficiency was measured by means of tests of muscular endurance, mental multiplication and typewriting tests, and chess problems. Only food of known composition was used so that calories might be accurately measured and the amount of protein, carbohydrates, and fat determined.

During the control period Mr. Holck ate whenever he desired and as much as he wanted. During "Fletcherizing," he ate only when hungry, stopped when he was satisfied, and masticated his food about twice as long as normally. Calory intake dropped from about 3,200 in the control period to about 2,800 during "Fletcherizing." His body weight fell about 30 pounds during this period but returned to its previous average in the last control period.

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Photographs Poor Character Guides

Psychology

Reading fortunes in faces is impossible for practical purposes, according to two psychologists who have conducted an experiment to determine whether vocational aptitude and success can be judged by careful study of photographs.

College graduates destined to become famous lawyers or surgeons carry no shining mark of success upon their youthful faces in photographs, at least none that an employer can rely upon. College boys who will never rise beyond a clerk's desk in a law office are apt to look just as keen and promising at graduation time.

The psychologists, Dr. Carney Landis and L. W. Phelps, of Wesleyan University, selected the five most successful lawyers, doctors, teachers, and engineers in a big university class that graduated 25 years ago, and also the five graduates who have attained the least worldly success in each of these fields. Photographs of the 40 men taken at graduation and 25 years later were shown to psychology students, who judged the success or failure of each and the line of work that would suit him best.

"In practically every case the observers disagreed and the same subject might be assigned to from ten to fifteen different vocations," the psychologists state, in reporting their investigation to the Journal of Experimental Psychology.

One successful engineer was thought by 10 of the 20 student judges to be clergyman. Six of them thought he was a successful clergyman and four decided that he was a failure at his church career. Another man, who, 25 years after graduation, holds a minor teaching post, was rated as a successful banker by six of the judges.

The popular belief that we can judge a man's ability and personality from seeing his photograph is not borne out by the evidence, the psychologists conclude. A photograph included in a letter of application for a job will not enable an employer to gain any positive idea of an individual's talents or his character, the investigation indicated.

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Why people of different countries pronounce the same sounds in different characteristic ways is being investigated at the University of Chicago.

Tremendous Trifles

History

EDMUND A. WALSH, in *The Fall of the Russian Empire* (Little, Brown):

The last Tzar of All Russias, far from being exempt from the psychological idiosyncrasies that influence men's judgment was notoriously subject to them. The shadow of a domestic tragedy lay across his latter years and clouded his reasoning powers. A baby's fingers had been tugging at his heartstrings for a decade, and the image of the Empress, battling for her boy's dynastic rights, held first place at every Council of the Empire.

There usually comes a moment in the conscious development of every human soul when some serious choice, or important decision, or difficult renunciation must be made, and made irrevocably. On that decision frequently depend the lives and fortunes of numerous other human beings—as happens in the case of the engineer of a fast express who discerns, dimly, but not surely, some danger signal set against him; or in the case of the navigator of an ocean liner adrift in a dangerous sea with a broken rudder. Such a moment came to Russia's supreme ruler in the spring of 1917. His decision affected 180,000,000 people.

Now, the instinctive, instantaneous reaction of the alert engineer as he reaches for the emergency brake, or the notions of a seasoned pilot as he endeavors to head his ship into the teeth of the storm instead of exposing his craft broadside to the fury of the waves, are not isolated, unrelated facts bearing no reference to previous training and habitual modes of action. Such coordination of sense preception, judgment, and manual execution is not the child of chance nor the unfailing perquisite of genius. It is the hard-won achievement of mental discipline. Men in the ways of human nature tell us, too, that there are few real accidents in the moral order, though there are many tragedies.

It was no stern necessity of war, nor gigantic despair, nor sudden conjunction of overpowering circumstances that drove Nicholas II into the course of action that wrecked his empire and provoked the revolution. His every decision and blunder was a palpable, traceable resultant of previous habits acquired with fatal facility. He lived in the grip of a hidden fear which, because it met him every morning at breakfast, dogged him through his hours of domestic privacy, and slept nearby in the nursery at night, had become inescapable and tyrannous. The elimination of Romanov rule, though inevitable in the long run and a political necessity if the Russian people were to survive, was measurably increased by a little prince's inherited weakness of physique and his tendency to bleed at the nose or fall into painful convulsions at the slightest bruising of his sensitive skin. Had her son not been a chronic hæmophilic, had she not been an abnormal hypochondriac, the Empress Alexandra might not have been the innocent tool for Rasputin's machinations, Russia might have been spared the scourges that came upon her, and the world might not have known the challenge of Bolshevism—at least not so soon. What men too frequently overlook in chronicling the causes of stirring historic events is the essential humanity of kings and queens and the influence exerted by relatively petty factors on the destiny of states and peoples. Had Anne Boleyn been less comely, Henry VII might never have repudiated Katherine of Aragon; there might have been no Spanish Armada, no schism, nor religious wars in England. A diamond necklace and a woman's vanity can never be disassociated from the inner history of the French Revolution and the hecatombs of heads that fell into its baskets. Neither can a withered arm be considered irrelevant by investigators of the role played by the German Kaiser in modern times.

That physical deformity, giving rise, during boyhood, to an inferiority complex in the last of the Hohenzollerns, stimulated a conscious—and legitimate—passion to overcome the handicap. The paralyzed hand was trained to rest in a natural way on the sword-hilt hanging at the Kaiser's left side; the feel and rattle of the ever-present saber became part of its wearer's nature and was a necessary adjunct of every photograph depicting Wilhelm in his favorite histrionic attitude. The fixed idea of personal majesty triumphing over physical limitations became a permanent obsession which transformed itself, eventually, into a political nervosity that unsettled Middle Europe from Berlin to Bagdad and would be satisfied with nothing short of a prominent place somewhere in the sun.

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The Well-Bred Indian

Ethnology

J. ALMUS RUSSELL in *The Dartmouth Alumni Magazine*:

All of the history of the peacetime and military events in which the red man had a part has been written by the "civilized" European or his descendants; this, almost without exception, has been biased in order to justify the white man's cruel treatment of the aborigine; only by the most painstaking study can the historian do justice to the noble savage, too often pictured as cruel, ignorant, and ignoble by the greedy colonist. . . .

Benjamin Franklin, in his *Remarks Concerning the Savages of North America* (1797), prefaced his paper by saying that the red man is called a *savage* because his manners differ from ours, which we think are the perfection of civility; "they think the same of ours." At the Treaty of Lancaster, in 1744, the Virginia Commissioners offered to take six Indian youths and educate them at William and Mary. They politely refused, saying (according to Franklin):

"Several of our young people were formerly brought up at the Colleges of the Northern Provinces; they were instructed in all your Sciences; but, when they came back to us, they were bad Runners, ignorant of every means of living in the Woods, unable to bear either Cold or Hunger, knew neither how to build a Cabin, take a Deer, or kill an Enemy, spoke our Language imperfectly, were therefore neither fit for Hunters, Warriors, or Counsellors; they were totally good for nothing. We are, however, not the less obliged by your kind Offer, tho' we decline accepting it; and, to show our grateful Sense of it, if the Gentlemen of Virginia will send us a Dozen of their Sons we will take great care of their Education, instruct them in all we know, and make Men of them."

The offer was received in silence, courteously refused, and a reciprocal proposition made. Civilization could not ask for more!

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"Northern Cross" Marks September Skies

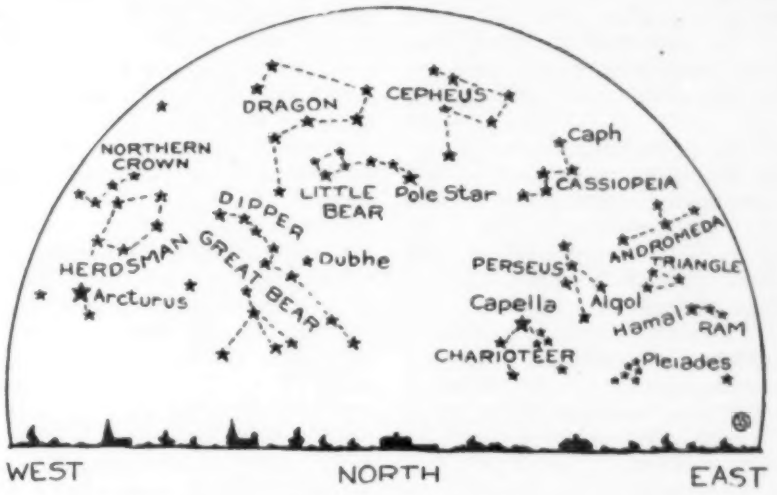
Astronomy

By James Stokley

A few months ago, the world was thrilled by the exploits of the airplane "Southern Cross," as it flew southward into regions where the original of its name, the celestial Southern Cross, or Crux, as the astronomer calls it, is visible. The constellation is one of those that never rise above the southern horizon for most people in the United States, though at certain times of the year it can just be seen from southern Florida—the southernmost part of our country.

There is, however, another cross—the Northern Cross—more properly known as Cygnus, the Swan. During September Cygnus is high overhead in the evening skies. The ancients conceived it as a swan in flight, with the long neck outstretched to the south, in which direction it is flying. Perhaps the fact that the birds of northern latitudes do fly southwards at this time of year suggested the name.

Though it more nearly resembles a bird in flight than some of the other star groups do their originals, most people will more easily see the cross than the swan. As a matter of fact, the nothern cross is more perfect than the southern, though it does not contain such bright stars. The Southern Cross consists of four bright stars which mark the extremities of the cross. There is no star at the intersection. In the northern cross there are five stars in the upright of the cross, one of which is at the intersection. The cross-piece is marked by two bright stars, one at either extremity.

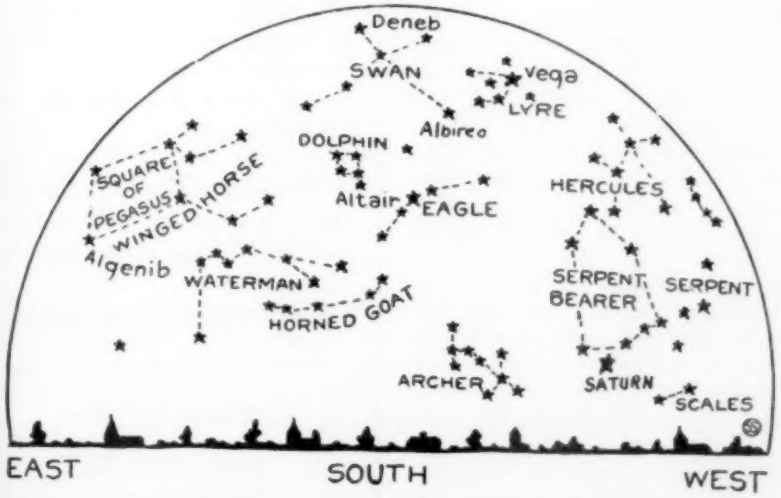


The map shows the location of Cygnus during the month. With its position almost overhead during the evening, and its characteristic shape, it is not hard to locate. Deneb, the bright star at the nothern end, or top, of the cross, is one of the six first magnitude stars now in the evening sky. Almost directly west of it is the brilliant Vega, in Lyra, the lyre, one of the others. To the south is Aquila, the eagle, containing the first magnitude Altair. Besides these three, which form a large and characteristic triangle of the autumn sky, there is Capella, of the constellation of Auriga, the charioteer, low in the northeast, and Arcturus, in Bootes, the bear-driver, are also visible. The sixth is seen low in the south. It is Fomalhaut, in Piscis Austrinus, southernmost of all the first magnitude stars ordinarily seen from these latitudes. The name of the constellation means the Southern Fish.

As for the planets of the month, Saturn is still the only one well placed for observation in the early evening. On the fifth it is in the position known as "quadrature." That means that it is 90 degrees east of the sun, or that when the sun sets, Saturn is directly south. Hence it is in the southwestern sky for about four hours after the setting of the sun. A little later in the evening Jupiter is visible in the southeast, but it is not shown on the map. At 2.57 a. m. it is directly south, and can be recognized by its great brilliancy—greater than any other body in the neighborhood except the moon.

The September evening skies are rather uneventful as far as happenings of a sensational nature are concerned. But there occurs on the 23rd an event that marks the end of one season and the beginning of another. At 2.06 a. m. Eastern Standard time, the sun enters the zodiacal sign of Libra the scales. This has been selected by astronomers to mark the beginning of autumn. However, there is no visible change that takes place in the sky at the time.

This year the sun has been of interest to astronomers because of the great number of spots that have appeared on it. Some of these have been large enough to be visible with the naked eye. Of course, it is not safe to look at the sun without some protection, such as smoked glass, or, even better, a piece of exposed and developed photographic film or plate. Above all, one should never try to look at (*Turn to next page*)



HOLD THESE MAPS IN FRONT OF YOU. The upper then shows you the northern and the lower the southern sky as it appears on September evenings

"Northern Cross" in Skies—*Continued*

the sun through a pair of binoculars or a field glass without such protection as the photographic film over both lenses. But with such a simple piece of optical equipment, many spots can be seen that could not otherwise be observed.

The reason that the spots are numerous this year is because of the fact that we are now practically at the sun spot maximum. The number of spots on the sun is not uniform, but varies in a cycle of eleven years, on the average. Once in this period they are particularly numerous. Then their numbers decrease, and a time comes when months may pass without the appearance of a single spot. But eleven years is only an average. Sometimes this cycle is several years shorter or longer, and it is only after the maximum has definitely gone by, and the spots are certainly on the decline, that the time of the maximum can be determined. Therefore, although many astronomers believe that this year marks the maximum, it may be a year or two before they can be certain.

Sun spots and terrestrial conditions are related, although many attempts to correlate weather with them have failed. Others have tried to use them to predict Wall Street panics, famines in India, the state of the Irish potato crop and the price of wheat, and there has been enongh correlation to mislead the advocates of these ideas. It is a fact that the sun is more active when there are more sun spots, and so sends out more radiation, or heat. But this increased heat results in somewhat more cloudiness over the earth as a whole, and so, at the time of sun spot maximum, the average temperatures of the earth are lower. The important thing is that this is an average for the whole earth, and so no one can say that because there is a large spot crossing the sun, it will rain on a certain day in a certain place.

There is another connection between sunspots and terrestrial events. That has to do with the aurora borealis, or northern lights. The sun spots are constantly sending out free electrons, pieces of the atoms of which matter is made. When produced in the laboratory, a stream of free electrons is called a beam of cathode rays, and when it shines on certain substances, such as minerals, or rarefied gases, they are caused to glow. When a spot is facing the earth, that is, when it is near the center of the sun's disc as seen from the earth, these cathode rays from the sun cross the 93 million miles separating it from the earth. Reaching the highly rarefied gases of the upper part of the earth's atmosphere, they excite these gases to luminescence, and cause the aurora.

There is still another effect. An electric current is believed to consist of a flow of electrons. Therefore this intense beam of electrons from the sun behaves like an electric current, and is surrounded by a magnetic field. This disturbs the magnetic field of the earth, and the result is often what is called a magnetic storm, which is an entirely different thing from an electrical storm. There is no visible effect, other than the auroræ, during such a storm, but the instruments of a magnetic observatory show it in various ways. The compass needle wavers, while strong electric currents are caused in telephone and telegraph lines. Sometimes such currents neutralize the currents already in use, and so make telegraphic communication impossible. At other times the earth current flows in the right direction, and it may even be possibile to telegraph for many miles with them alone, and without the aid of batteries. Curiously enough, radio is practically unaffected by a magnetic storm, though an electrical storm may cause enough static to stop its use.

But even the magnetic disturbances are not an absolutely certain consequence of a sun spot, as was shown only a few months ago. On July 7 a large sun spot passed across the meridian of the sun. When most nearly on line with the earth an exceedingly severe magnetic storm occurred. Displays of northern lights were seen as far south as Texas, in regions where they had almost never been noticed previously. A few days later another, an even larger spot, appeared, gradually moving to the center of the sun's disc. It came even more nearly on line with the earth than its predecessor, but the magnetic instruments behaved perfectly. So sun spots are rather too uncertain to be taken as prophets!

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The rise of commercial airplane service in Alaska has already cut down the use of dog teams.

Helen Keller Shows Future of Brain—*Continued*

Laura Bridgman, famous deaf-blind girl of the nineteenth century, had an acute sense of direction.

The difference is traced to the fact that Laura Bridgman had a certain degree of sight in one eye up to the age of eight. Before that time she had guided herself to some extent and had a feeling of space and direction which remained with her in her sightlessness. But Helen Keller's sight was lost through an obscure disease when she was only 19 months old, and the retina of the eye soon atrophied, before she had had time to gain impressions of herself in relation to the world around her.

This difference between the two girls fits in with Dr. Tilney's theory as to a ninth sense. Adding up the senses, there are five well-known guiding senses which make us aware of the world around us, and the two body senses which keep up aware to a certain extent of the skeletal and visceral machinery of the body, and an eighth sense which Dr. Tilney calls the sense of hurt, which warns us against injury, such as extreme heat, a crushing pressure, or a cut. To these, he believes it may be possible to add a ninth sense which would explain the mysterious homing of the pigeon and the straight, sure flight of birds to their summer and winter homes. Experiments now under way at Columbia University indicate that this ninth sense may prove to be a magnetic sense located in the retina of the eye.

So, to return to Helen Keller and Laura Bridgman, the latter had a retina which may have functioned magnetically even in blindness to aid her a little in sensing direction. Whereas, Miss Keller, lacking this aid almost from birth, illustrates the negative side of the case.

From his study of Helen Keller Dr. Tilney said:

"I concluded that her fundamental primary senses are no better than ours. The great difference exists in her use of the senses by development of the brain."

Just as we fix in our brains the association between a rose and the colors pink, red, and yellow, so Helen Keller has fixed in her brain the distinction between the fragrance of the American Beauty, the LaFrance, and the Jacqueminot roses. She has no short cut to knowing the world by miraculous means. Every association of touch, smell, or taste has been built up in the remarkable storehouse of her brain, by the same process that any of us acquire a piece of information. And in the neurologist's opinion, "it is impossible for any of us to fool the brain by shorts cuts in the upbuilding of its best associational powers."

There were three questions that Dr. Tilney hoped to answer when he studied this remarkable woman's brain development, and the three questions were answered.

He wanted to know whether the way in which she learned to use her brain would be of any use in ordinary education. He found that her teacher made full use of an important educational principle that is often overlooked. In teaching Helen to use her lips in forming words, to spell, or to do arithmetic, the implements of learning were always recognized as a means to an end. She learned, in the face of difficulties that we can scarcely imagine, because from the first her teacher made her realize that learning was the means by which she could enjoy life more fully.

One incident shows how her mind has absorbed and held knowledge, as a result of her patience, concentration, and her great intellectual interest. At Dr. Tilney's re- (*Turn to next page*)

Relaxation Cure for Nervousness

Physiology

Complete relaxation, deeper than the average sleep, is the treatment for certain nervous disorders evolved by Edmund Jacobson, research associate in physiology at the University of Chicago. The new treatment is the result of a twenty-year period of clinical observation and laboratory research. Although he is continuing his experiments, Dr. Jacobson will publish his results soon in a book to be entitled "Progressive Relaxation."

The "relaxation," which concerns all the voluntary muscles of the body, is described by Dr. Jacobson as "entirely different, yet related to the popular idea of muscular relaxation." That is, if a person lies down to rest, he relaxes most of his major muscles, but the complete relaxation achieved by Dr. Jacobson on his patients and laboratory assistants really begins at this point. Starting with tension of muscle groups, including the smaller muscles such as those of the neck, eyes, fingers and toes, the individual is advised to avoid all sensation of tenseness. Experiments on the knee jerk and with electrical stimulation indicate that trained individuals are able to achieve a state of relaxation deeper even than that of the average sleeper.

"Insomnia yields readily to this treatment," said Dr. Jacobson, "and all the cases of chronic spastic colon or esophagus to which I have had access, have shown marked improvement or cure."

Spastic colon and esophagus are conditions of the upper and lower portions of the alimentary canal in which nervousness of the patient results in more or less permanent contraction with severe discomfort and pain. X-ray photographs of these regions before and after relaxation treatment reveal the improvement.

"This is a case," said Dr. Jacobson, "in which relaxation of the voluntary muscles induces relaxation of the involuntary muscles. In addition to this undeniable relief for nervous persons, it is my belief that complete relaxation periodically should have a tonic effect upon the entire system with general elevation of health and resistance to disease."

"Denicotined" Tobacco

Chemistry

"Denicotinized" or "denicotined" tobacco which has recently appeared on the market in the form of cigarets, cigars and smoking tobaccos, is little more than a fraud, according to a report of experiments made by chemists of the Connecticut Agricultural Experiment Station. Samples of these "denicotinized" brands showed, on analysis, 72 per cent. of the amount of nicotine contained in the average unprocessed brands.

Some of the popular brands of cigarets and smoking tobaccos actually contained less nicotine than some of the processed brands. Nine kinds of widely advertised and well known cigarets, three kinds of cigars and four kinds of smoking tobacco were examined and compared with the alleged "denicotinized" brands.

The term "denicotinized" or "denicotined" is naturally taken to mean practically free from nicotine, whereas in the brands sold under that description, the cigarets contained from 2.32 to 0.94 per cent. of nicotine. The popular unprocessed cigarets examined showed from 1.28 to 2.89 per cent. Un- (*Turn to next page*)

Helen Keller Shows Future of Brain—*Continued*

quest, she wrote him a long letter about the sense of smell. In it, she quoted passages from the old Greek philosophers, from Shakespeare, from Pierre Loti, and other authors who have expressed themselves on this unpopular sense. The quotations were brought in casually from memory, and at the end she recalled that the Bible contained many passages on the subject of smell which she would like to comment upon sometime.

The neurologist concludes that Helen Keller's education does set a standard for normal children in a number of ways, and he summarizes them as follows:

"Education is a continuous process of associations being formed in the brain. Teachers should distinguish clearly between the implements necessary to learning and the useful and toward which the child is working. Education should foster curiosity and expand with the growth of curiosity. There should be pleasurable interest in learning. Education should cultivate the process of concentrated attention. And education should produce the fullest adjustment to life."

The second question that the neurologist set himself to answer with Miss Keller's help was: Does she demonstrate that humanity in general has not yet begun to make the best use of its brain power?

That question was answered plainly by the tests, and the answer was summed up in the arithmetic problem, showing that man's brain of which he is so proud is just about 20 per cent. efficient by the standard Miss Keller's brain has set.

The third and last question was: Does she demonstrate that further development may lie before the human race when the unutilized gifts of the brain are actually realized?

The answer to this is, yes, he concludes: "There is a mechanism in the brain for much more ample understanding of the world in which we live."

"The pessimist," says Dr. Tilney, "may have some justification for saying that there has been little real progress in man's brain during the several thousand years of historic record. But to my mind the real process of man's development, including brain power, is a matter of evolution. It is entirely demonstrable that man began with a small and poor brain, as shown in the ape-like man of 500,000 years ago. And he has developed step by step a better brain so that the modern man has a far more efficient brain than the brain primitive man began with.

"There is no reason to believe that the brain of today is a finished product, as many people do think. It is much more likely that it represents an intermediate phase in evolution."

Besides the visible evidence of man's progress from the little 940-gram brain of his oldest known ancestor up to the modern brain which weighs some 1,300 grams, there is a new force in evolution, Dr. Tilney points out.

"For millions of years," he says, "the evolutionary process has been going on in its own way. But now, a new power has stepped in, namely, intelligent men and women have begun to recognize that there is a process of evolution. When they understand more fully the nature of the process, they may be able to apply it to the future development of the master organ of life—the human brain."

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"Denicotined"—*Cont'd*

processed cigars ranged from 1.16 to 1.90 per cent., the "denicotined" from 0.67 to 1.07 per cent. Smoking tobaccos unprocessed, contained from 1.45 to 2.09 per cent., the "denicotinized" from 0.97 to 2.26 per cent.

Obviously it is better to buy the standard unprocessed brands which are known to have a low nicotine content, especially as the purchaser will then have no false sense of security to lull him into the consumption of a greater amount of tobacco, the report recommends.

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In a government survey of time lost from work by 5,000 women employed in cotton mills, it was found that women who work 55 hours a week were absent from work 13 more days in a year than women who work 48 hours.

The International Boundary Commission is to set about preparing maps and reports showing the exact latitude and longitude of the entire 4,000-mile Canada-United States boundary line, so that the facts may never be questioned.

Bird life is less abundant in the wilderness than in regions cultivated by man.

A study of deaths in Illinois showed that only four diseases took more lives than accidents.

Parasite Students

Psychology

The parasite student, who slips through college by cribbing information from more industrious or more brilliant students, has at last been made useful. Unknown to themselves, 30 successful cheaters at Colgate University were studied by Herbert C. Brownell and used as laboratory specimens showing the mental and emotional traits of college men who cheat at examinations—and get away with it.

Information about the 30 was obtained by underground and unofficial channels, Mr. Brownell states in reporting his investigation to School and Society. None of these cheaters were officially caught, even by a severe proctoring system.

Eighty per cent. of the group were more psychoneurotic, or emotionally unstable, than the campus average. More than half (*Turn to next page*)

Cold Good for Oats

Plant Physiology

Hardship in youth is good for oats, as it is said to be good for human beings. This grain of the North thrives best and ripens earliest when it is sprouted at a low temperature, experiments by Prof. N. Maximow, noted Russian plant physiologist, indicate.

Prof. Maximow exposed seed grain to temperatures of about 42 degrees Fahrenheit, only about ten degrees above freezing. The stalks from these seeds headed out earlier than those from seeds sprouted at a warmer temperature. This was true even when the early chilling period lasted only for a few days, and the two lots of grain were grown at the same temperature for the rest of their lives. It was found that this treatment held good for all plants that have a late ripening period.

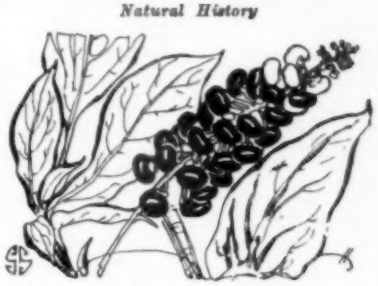
The experiments give scientific point to an old Russian folk saying: "If you want to grow rich fast, sow your oats in the mud." It has long been held by the peasants that the best time for sowing oats is while the fields are still muddy (and hence chilly) from the melting of the winter's snow.

Another striking example of the effect of early influences was obtained by Prof. Maximow, working on the influence of light. He found that the effects of artificially lengthening or shortening the day for plants were just about as pronounced when the treatment was carried on for a short period during (*Turn to next page*)

Nature Ramblings

By Frank Thone

Natural History



Pokeberry

Almost all of our commonest weeds are foreigners; for it seems axiomatic that an ill weed thrives best away from its own home. But one American plant can claim the somewhat doubtful distinction of sometimes amounting to a troublesome weed on its native heath. This is the pokeberry, or pokeweed, also known simply as poke, and as scoke and garget.

Weed though it is, it is not without redeeming qualities. Prof. Liberty Hyde Bailey, who always has the right word when it comes to botanical description, calls it "a robust plant of heavy odor, but of good habit and clean." Right now, with summer flowers one by one folding up against the coming frosts, the pokeweed helps by gauding the corners with stiff bunches of berries that are so purple they are almost black.

Those same berries yield quantities of most amazingly purple juice, which children often make into ink for their own amusement and their mothers' despair. They might do for a dye, but the color has never yet been fixed. It is another case of a possible occupation for a vegetable gone because of aniline competition.

In earlier days, and to a certain extent still, the thick, asparagus-like shoots of the pokeweed furnished pot herbs. They were a trifle rank in taste unless taken in the very flush of their crisp infancy, but in the lack of asparagus would do all right. They were even cultivated once, but that has passed.

The roots of the plant are yellow and intensely bitter, yielding a violent purgative drug. Eaten by accident for horseradish, they have caused serious illness and even death. So that use is gone, too.

Robbed of all its possible occupations, is it any wonder that the pokeberry has become a vagabond and a weed?

Solomon's Stables

Archaeology

One of the great stables of King Solomon has been uncovered by a field party of the Oriental Institute of the University of Chicago, working at Armageddon. Preliminary dispatches had led James Henry Breasted, director of the Oriental Institute, who left recently to represent the United States at the 17th International Congress of Orientalists at Oxford, England, to suppose that the discoveries were Solomon's stables and the formal report just received indicates that he was correct.

The material thus far uncovered reveals the remains of what must have been a magnificent establishment.

"The newly discovered stables," reports Dr. P. L. O. Guy, field director, "where Solomon kept his horses at Megiddo, were laid out very systematically. The stalls were arranged in double rows. The horses therefore stood in rows of twelve, facing each other. Between each two rows of heads was a passage for the grooms and the keepers of the horses to control and feed them. In front of each horse was a stone manger and the rows of mangers were divided into sections by massive stone hitching posts, which still stand, containing the original tie holes for the insertion of the halter rope."

In commenting on Dr. Guy's report, Dr. Breasted said: "Among the many significant finds already made by the expedition, the discovery of the stables of Solomon, whose name is synonymous with the magnificence of ancient Oriental autocracy, is of the greatest historical importance. Few people are aware," continued Dr. Breasted, "that Solomon, true to the instincts of his race, was not only an Oriental sovereign but likewise a successful merchant (*Turn to next page*)

Films for Color Values

Photography

Amateur photographers with roll film cameras can now take pictures of colored objects in which light red objects appear light, while a dark blue photographs dark. A large British film manufacturing concern is now producing "panchromatic" roll films. These do not take pictures in natural colors, but they do reproduce color values correctly. With ordinary films red photographs black or very dark, while blues appear very light.

Panchromatic plates have been on the market for (*Turn to next page*)

Solomon's Stables—*Cont'd*

whose dealings extended into the neighboring kingdoms about Palestine. Not least of his activities were his enterprises as a horse dealer. His close connection with the Egyptian court gave him inside opportunities for securing the finest breeds of Egyptian horses."

Dr. Breasted went on to quote from the Old Testament, the passages which indicate that the stables uncovered at Megiddo are really those of Solomon. "And the horses which Solomon had were brought out of Egypt; and the king's merchants received them in droves, each drove at a price. And a chariot came up and went out of Egypt for six hundred shekels (10 pounds) of silver, and a horse for a hundred and fifty (2½ pounds); and so for all the kings of the Hittites, and for the kings of Syria, did they bring them out by their means (I Kings X, 28-29).

"Solomon's record also states," said Dr. Breasted, "that he bestowed those horses in the chariot cities and with the kings at Jerusalem. We are told in the old Testament record that one of these chariot cities was Megiddo, and Megiddo is the Hebrew name for the great fortified city which was later known as Armageddon."

The excavating party, according to Dr. Guy, is now investigating a layer in the mound which was covered about 3,000 years ago, at just about the time of Solomon. Besides the interesting discovery of the stables, the clearing of Armageddon is disclosing a coherent, well laid out town, with streets and connected buildings. The Jerusalem of Solomon's time has, of course, completely disappeared and this is the first attempt at restoration of a town plan of his age.

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Films for Color—*Cont'd*

some years, while similar film has been made for use in movie cameras. However, it has never been obtainable before for roll film cameras, which are most commonly used. The film is not very much more expensive than the ordinary kind, however, since a six exposure film in the 3a, or 3¼" by 5½", size costs 75 cents. As the films are sensitive to red light, they cannot be developed with the ordinary red dark room lamp. The manufacturers, however, will develop them. They charge 25 cents for developing the 3a size.

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Multum in Parvo

Biology

GARY N. CALKINS, in *Biology of the Protozoa* (Lea and Feabiger):

In the lower Metazoa the organ systems are less highly specialized; fewer organs are present to perform the same fundamental vital activities and the tissue cells have relatively more kinds of work to do for the organism as a whole. Thus the supporting and covering cells of a cœlenterate combine the functions of respiration, irritability, muscular contraction, excretion and circulation with the primary functions of an epithelium. Each of them is more nearly balanced physiologically than a single cell of the higher types, but it still needs the activities of other cells, and the organism is again the sum-total of all its cellular parts.

In the protozoön, finally, we find a cell which is physiologically balanced; it is still a cell and at the same time a complete organism performing all of the fundamental vital activities within the confines of that single cell. Whitman, in his essay on "The Inadequacy of the Cell Theory" clearly expressed the inconsistencies in the common use of the designation "cell" for this variety of structure.

As organisms the Protozoa are more significant than as cells. In the same way that organisms of the metazoan grade are more and more highly specialized as we ascend the scale of animal forms, so in the Protozoa we find intracellular specializations which lead to structural complexities difficult to harmonize with the ordinary conceptions of a cell. In perhaps the majority of the Protozoa the fundamental vital activities are performed, as in the simpler Amœbæ or simple flagellates, by the protoplasm as a whole and without other visible specializations than nucleus and cell body. In other forms, however, intracellular differentiations lead to intracellular division of labor which in some types becomes as complicated as are many of the organisms belonging to the Metazoa. Thus *Diplodinium ecaudatum*, one of the Infusoria, according to Sharp, has intracellular differentiations of extraordinary complexity. Bars of denser chitinous substance form an internal skeleton; special retractile fibers draw in a protrusible proboscis; similar fibers closing a dorsal and a ventral operculum; other fibrils, functioning as do nerves of Metazoa, form a complicated coöordinating system.

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Parasite Students—*Cont'd*

fell below the campus average in intelligence, and the majority belonged to the psychological type known as extroverts; that is, good social mixers and more inclined to activity than to thinking.

"Contrasted with the student body, the cribber becomes a psychological type," Mr. Brownell concludes.

"His low intelligence may make cheating somewhat of a necessity. His extroversion may operate to further this. His emotional instability may make it easier for the spirit to succumb under the twofold necessity."

More than half the college cheating could be eliminated if this psychological type were eliminated. With the general type would go most of the "all-round" college men who shine in team and track contests, glee clubs, dramatic productions and other bookless college activities.

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Cold for Oats—*Cont'd*

the early seedling stage as when it was persisted in to maturity. According to its specific nature, a plant would ripen its seeds early under the stimulus of lengthened or shortened daylight hours, even though that stimulus had been applied weeks before the ripening period and then withdrawn.

Plants are not concerned primarily with the whole of the white daylight when they respond to artificial darkening, Prof. Maximow discovered. He tried cutting off parts of the light supply, and found that when red and yellow light was withdrawn the plants acted as though they were in the dark, so far as their response to the length of day was concerned.

Science News-Letter, September 8, 1928

A normal three-weeks-old baby can hang by its hands longer than the average adult.

The oldest Latin writing is four words engraved on a gold pin of about 550 B. C.

For the first time, explorers have climbed Mount Sorata, in Bolivia, 21,500 feet high, and have made a careful map of the mountain.

FIRST GLANCES AT NEW BOOKS

PREHISTORIC MAN—Keith Henderson—*Dutton* ($3). At last, prehistoric men made human, not by novelizing them, but by discussing them in most readable and picturesque fashion. It is a surprisingly complete account, too, starting out with brief, clean-cut chapters on the evolutionary prelude to man's appearance, and then taking up the drama of progress, including chapters on "The Strange Mousterian", "Mammoth Hunters at Predmost", "The Temple Builders", "Copper Age Men in Egypt", "Bronze Age Men in China"—and so on. A large assortment of illustrations enables the author to introduce the reader painlessly to many facts about primitive skulls, weapons, and the art and industry of ancient men.

Anthropology

Science News-Letter, September 8, 1928

HIDASTA EAGLE TRAPPING—Gilbert Livingstone Wilson—*American Museum of Natural History* ($1.50). Indian technique in hunting described in detail, with many stories and records obtained from the Indians.

Anthropology

Science News-Letter, September 8, 1928

LONG LANCE—Chief Buffalo Child Long Lance—*Cosmopolitan* ($2.50). If you have puzzled to understand why the Indians tortured themselves, what their ideas of education were, and what an Indian boy really did with his time—this book will make the strange Indian ways seem reasonable and practical. It is a "different" book about Indians, by a Blackfoot boy brought up to be an Indian brave, in the Northwest, before the white men had ever penetrated to that remote region. Now, after a college education, after distinguishing himself in war in the Canadian army, and after experience in writing for newspapers and magazines, the Indian takes his skill with words, which is considerable, and recalls a remarkable boyhood.

Ethnology

Science News-Letter, September 8, 1928

CAMELS!—Daniel W. Streeter—*Putnams.* A good-natured account of a pair of amateur explorers in Africa. Contains considerable interesting material on the desert and grassland fauna, especially the African varieties of *Homo sapiens.*

Travel

Science News-Letter, September 8, 1928

THE SOCIAL INSECTS, THEIR ORIGIN AND EVOLUTION—William Morton Wheeler—*Harcourt, Brace* ($7). Entomologists, and naturalists generally, need only to know that Prof. Wheeler has published another book to know that here is another book which they will want to read themselves and pass on to their students. It were an impertinence as well as a waste of time to comment on the text; one can add, however, that the illustrations keep it fair company. How such good photographs of such difficult subjects can be obtained is hard to imagine.

Entomology

Science News-Letter, September 8, 1928

LEAF-MINING INSECTS—J. G. Needham, W. Frost and Beatrice H. Tothill—*Williams and Wilkins* ($6). A thorough-going treatise on one of the most troublesome groups of insect pests. This is one of the books that becomes indispensable to the well-equipped entomological library through the simple fact of its existence.

Entomology

Science News-Letter, September 8, 1928

THE GASTEROMYCETES OF THE EASTERN UNITED STATES AND CANADA—William C. Coker and John N. Couch—*University of North Carolina Press* ($12). The authors have deserved the gratitude of botanists generally, and of mycologists especially, for this complete monographing of a difficult fungus group whose literature has hitherto been very much scattered. There are 123 plates, most of them lithographed.

Botany

Science News-Letter, September 8, 1928

ROCK GARDENS—F. F. Rockwell—*Macmillan* ($1). A compact little book, telling how to construct rock gardens of various types and what plants to put in them, well illustrated with pen-and-ink sketches.

Horticulture

Science News-Letter, September 8, 1928

BAMBI, A LIFE IN THE WOODS—Felix Salten—*Simon and Schuster*—($2.50). The story of a spotted fawn—Bambi—who grows to be a great stag. You hear the chatter of squirrel and magpie; feel the swirl of winter snow; see the beauty of summer sun slanting through the trees. The charm of the forest is in this book.

Nature Study

Science News-Letter, September 8, 1928

SCIENTIFIC REPORTS PRESENTED TO THE SIXTH INTERNATIONAL CONGRESS OF HISTORICAL SCIENCES, OSLO, 1928. *Bulletin of the International Committee of Historical Sciences, No. 5, July,* 1928. Committee Headquarters: 907 Fifteenth Street, Washington, D. C. These important papers are rather reports on the work which has been done and which remains to be done in certain fields of history than completed essays in themselves. Such topics as the origins of nationalism, the importance of the enlightened despots of the eighteenth century, and the development of banking are placed in the setting of modern knowledge. One American study finds place, "The Present State of Knowledge of American History and Civilization Prior to 1492," by Dr. Alfred V. Kidder of the Carnegie Institution of Washington.

History

Science News-Letter, September 8, 1928

A LABORATORY MANUAL OF ELEMENTARY PHYSICAL CHEMISTRY—Edward Mack and Wesley G. France—*Van Nostrand* ($2.00). Thirty-five experiments which when performed will give an insight into heat, gases, colloids, catalysts and a multitude of other useful and sometimes mysterious things.

Chemistry

Science News-Letter, September 8, 1928

PETROLEUM AND ITS PRODUCTS—William A. Gruse—*McGraw-Hill* ($4.50). Liquid fuel that comes from the ground has become so important today that this excellent summary of petroleum, its refining and its distribution will prove useful on many reference shelves.

Chemistry

Science News-Letter, September 8, 1928

HIGH SCHOOL CHEMISTRY—George Howard Bruce—*World Book Company* ($1.68). One of those nice, clean, clear and concise textbooks characteristic of the "New-World Science Series."

Chemistry

Science News-Letter, September 8, 1928

STANDARD TIME CONVERSION CHART—Bureau of Standards, Miscellaneous Publication No. 84—*Government Printing Office, Washington* (10 cents). To find the time of day in Zululand or Paris, this device is helpful.

Astronomy

Science News-Letter, September 8, 1928

Measurement and Human Life

Mensuration

By HENRY D. HUBBARD

(Dr. Hubbard is secretary of the U. S Bureau of Standards.)

The Greek philosopher Protagoras begins one of his books with the words "Man is the measure of all things." Truly man is the measurer, and measurement is his master art. The very word "man" from the Sanskrit means "mind" and "measure." Measurement is more than an art—it runs through all arts, sciences, industries—it is man's master art.

Measurement is a pioneer. Early history writ on trees or rocks marked by notches the height of flood and the passing days. Man measured the earth—Geometry; the turning shadows of the day—Chronometry; the stars and their motions—Astronomy; the seasonal migrations of the sun—Chronology. Early life depended upon measuring the turn of the year, when the sun starts north and seed-time nears. The pyramids of the Pharaohs were great Sundials of the Seasons, the length of whose noon shadows fixed the best planting time to assure needed crops on which wealth and even survival depended.

Here is a shoe factory with a houseful of wooden shoe forms or lasts. The shoe last sums up ages of shoemaking art in a group of measures — length, width, instep, ankle—by which the shoe is built, classified, sold, and worn. Foot comfort is built to measure on the last and foot measures dictate every step in shoemaking. However strong, durable, or artistic the shoe, correct measure is the one demand which cannot be ignored.

A dress pattern sums up an age-old art—clothing the body. The pattern is a complex of measures. In every line is the skill of garment maker and fitter. The word "mode" means "measured" for the clothier's art is a measured art. Artists of the mode build their creations on measures of the body. Every cut of the shears or stitch of the needle is measured to ensure perfect fitting for comfort, taste, or health.

Feeding the race, a primary need, creates countless recipes which set to measure the skill of the cook, and thus make reproducible a host of delectable dishes. The success of every feast depends upon the measurements which assure perfection in the culinary masterpieces. We measure calories and nitrogen for bodily energy and repair, for dietetics is a measured art. With the calorimeter to measure bodily need and food values we may feed scientifically and thus open a new era for man as we have for motors.

What is true of the shoe last, the dress pattern, and the recipe is true of a hundred thousand products of industry. Everywhere perfect service means measured service. Measures are the scaffolding, quality is the structure. The machine knows only the measures, the user only the quality. The automobile connotes not the forty thousand measurements by which it is made but rather it connotes easy, and rapid transport.

The role of measurement in medical research and practice would make a fascinating volume. Measurement is the greatest means of diagnosis and treatment. We measure man, his muscles—their size and strength, his reaction times, respiration rate and volume, blood pressure and the density of its corpuscular population; his senses, their acuity and defect. These measured data are the matrix for prescriptive regime. They help perfect the human body and normalize its powers. Measurement is its chief aid in this supreme task. The white rat, probably the best measured animal, is being used to measure a thousand vital facts and factors of life itself, and the measured results are being used to perfect human life.

Through measures our houses may be heated or cooled, the air moistened or dried, and air movement made optimum. The complete control of indoor climate through measurement is a coming art which will bring amazing conditions of comfort, health, and personal efficiency for rest, work, or recreation.

The mariner still hitches his wagon to a star, for measurement was born among the stars. The star-gazing dreamers of yesterday gave us astronomy, chronometry, the calendar, surveying, geometry, and the art of navigation.

Modern science began with measurement. We measure the work to recreate the time-table of geology. We measure tree rings to learn the life story of the tree, and through such measures these tongues in ancient trees retell climatic history centuries past.

To science measurement is a means to discovery, prophecy, control. To industry it is the tool of creation. The measured curves of every tool are alert with the treasured skill of a race of craftsmen. The machine itself is a complex of measures which set each craft to cosmic power.

All industry measures to serve. Its every deed fits a measured need, whether of size, strength, color, or whatever gives utility to things. Industry is service set to measure. We measure the body to clothe it with measured apparel. Our life itself fits into measured schedules of time and place.

Measures are the life of the fine arts—poetry sings in measures, sculpture carves them into inspirations, architecture enshrines them, and the measured periods of tone and silence, their sequence and concord, transmute the soul of the master musician into harmonies for the joy of the world.

Measurement is miracle worker. We give a measured curve to glass to match a measured defect of the eye and restore sight to the aged and perfect the vision of youth. Everywhere measurement is busy creating the tomorrow of our dreams. Man's miracles multiply, break the chain of time, place, and circumstance to give him vast degrees of freedom and new and limitless powers. Little wonder that Emerson, facing the new age of science and its possibilities, declared "I have never known a man as rich as all men ought to be."

Measurement is truth and sets men free. Everywhere it has one true purpose, the maximum happiness for all.

Science News-Letter, September 8, 1928

Who Carnot Was

History of Science

Sadi Nicolas Leonhard Carnot, whose classic on thermodynamics is reprinted in this week's SCIENCE NEWS-LETTER, was born in Paris on June 1, 1796, and died there August 24, 1832, of cholera. He started his career with a commission in the army, but his father's political connections prevented the young man's achieving any but minor posts, so he resigned his commission to devote himself to mathematics, chemistry, natural history, technology and political economy. His only published work, on the motive power of heat, contains only a fragment of his scientific discoveries, but it puts him in the very foremost rank, though its full value was not recognized until pointed out by Lord Kelvin.

Science News-Letter, September 8, 1928

CLASSICS OF SCIENCE:

Carnot Cycle

Physics

An Account of Carnot's Theory of the Motive Power of Heat; with Numerical Results deduced from Regnault's Experiments on Steam, by William Thompson (Lord Kelvin), Professor of Natural History in the University of Glasgow. Proceedings of the Royal Society, Edinburgh, 1848-49.

CARNOT'S *Theory of the Steam-Engine*

Let C D F_2 E_2 be a cylinder, of which the curved surface is perfectly impermeable to heat, with a piston also impermeable to heat, fitted in it; while the fixed bottom C D, itself with no capacity for heat, is possessed of perfect conducting power. Let K be an impermeable stand, such that when the cylinder is placed upon it the contents below the piston can neither gain nor lose heat. Let A and B be two bodies permanently retained at constant temperatures, S^0 and T^0, respectively, of which the former is higher than the latter. Let the cylinder, placed on the impermeable stand, K, be partially filled with water, at the temperature S, of the body A, and (there being no air below it) let the piston be placed in a position E F, near the surface of the water. The pressure of the vapour above the water will tend to push up the piston, and must be resisted by a force applied to the piston.* till the commencement of the operations, which are conducted in the following manner:

(1.) The cylinder being placed on the body A, so that the water and vapour may be retained at the temperature S, *let the piston rise any convenient height* E E_1, *to a position* E_1 F_1, *performing work by the pressure of the vapour below it during its ascent.*

[During this operation a certain quantity, H, of heat, the amount of latent heat in the fresh vapour which is formed, is abstracted from the body A.]

(2.) The cylinder being removed, and placed on the impermeable stand K, *let the piston rise gradually, till, when it reaches a position* E_2 F_2, *the temperature of the water and vapour is* T, *the same as that of the body* B.

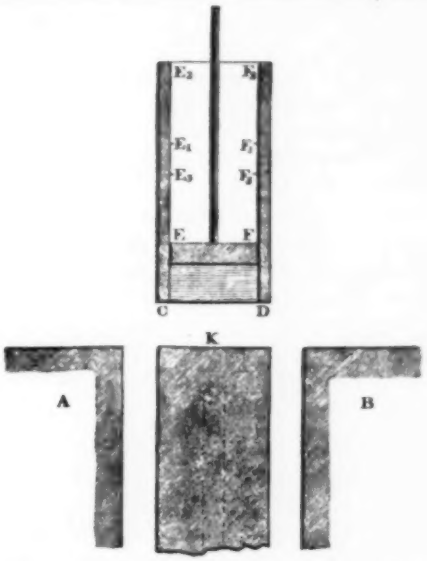

Diagram of the apparatus postulated in Carnot's Theory

[During this operation the fresh vapour continually formed requires heat to become latent; and, therefore, as the contents of the cylinder are protected from any accession of heat, their temperature sinks.]

(3.) The cylinder being removed from K, and placed on B, *let the piston be pushed down, till, when it reaches the position* E_3 F_3, *the quantity of heat evolved and abstracted by* B *amounts to that which, during* the first operation, was taken from A.

[During this operation the temperature of the contents of the cylinder is retained constantly at T^0, and all the latent heat of the vapour which is condensed into water at the same temperature, is given out to B.]

(4.) The cylinder being removed from B, and placed on the impermeable stand, *let the piston be pushed down from* E_3 F_3 *to its original position* E F.

[During this operation, the impermeable stand preventing any loss of heat, the temperature of the water and air must rise continually, till (since the quantity of heat evolved during the third operation was precisely equal to that which was previously absorbed), at the conclusion it reaches its primitive value, S, in virtue of Carnot's fundamental axiom.]

At the conclusion of this cycle of operations† the total thermal agency has been the *letting down* of H units of heat from the body A, at the temperature S, to B, at the lower temperature T; and the aggregate of the mechanical effect has been a certain amount of *work produced*, since during the ascent of the piston in the first and second operations, the temperature of the water and vapour, and therefore the pressure of the vapour on the piston, was on the whole higher than during the descent, in the third and fourth operations. It remains for us actually to evaluate this aggregate amount of work performed; and for this purpose the following graphical method of representing the mechanical effect developed in the several operations, taken from Mons. CLAPEYRON'S paper, is extremely convenient.

Let O X and O Y be two lines at right angles to one another. Along O X measure off distances O N_1, N_1 N_2, N_2 N_3, N_3 O, respectively proportioned to the spaces described by the piston during the four successive operations described above; and, with reference to these four operations respectively, let the following constructions be made:—

(1.) Along O Y measure a length O A, to represent the pressure of the saturated vapour at the temperature S; and draw A A_1 parallel to O X, and let it meet an ordinate through N_1, in A_2.

(2.) Draw a curve A_1 P A such that, if O N represent, at any instant during the second operation, the distance of the piston from its primitive position, N P shall represent the pressure of the vapor at the same instant.

(3.) Through A_2 draw A_2 A_3 parallel to O X, and let it meet an ordinate through N_3 in A_3.

(4.) Draw the curve A_3 A such that the abscissa and ordinate of any point in it may represent respectively the distances of the piston from its primitive position, and the pressure of the vapor, at some instant during the fourth operation. The last point of this curve must, according to Carnot's fundamental principle, coincide with A, since the piston is, at the end of the cycle of (*Turn to next page*)

*In all that follows, the pressure of the atmosphere on the upper side of the piston will be included in the applied forces, which, in the successive operations described, are sometimes overcome by the upward motion, and sometimes yielded to in the motion downwards. It will be unnecessary, in reckoning at the end of a cycle of operations, to take into account the work thus spent upon the atmosphere, and the restitution which has been made, since these precisely compensate for one another.

†In Carnot's work some perplexity is introduced with reference to the temperature of the water, which, in the operations he describes, is not brought back exactly to what it was at the commencement; but the difficulty which arises is explained by the author. No such difficulty occurs with reference to the cycle of operations in the text, for which I am indebted to Mons. Clapeyron.

Carnot Cycle—*Continued*

operations, again in its primitive position, and the pressure of the vapor is the same as it was at the beginning.

18. Let us now suppose that the lengths, O N_1, N_1 N_2, N_2 N_3 and N_3 O, *represent numerically* the volumes of the spaces moved through by the piston during the successive operations. It follows that the mechanical effect obtained during the first operation will be *numerically represented* by the area A A_1 N_1 O; that is, the number of superficial units in this area will be equal to the number of "foot-pounds" of work performed by the ascending piston during the first operation. The work performed by the piston during the second operation will be similarly represented by the area A_1 A_2 N_2 N_1. Again, during the third operation a certain amount of work is spent on the piston, which will be represented by the area A_2 A_3 N_3 N_2; and lastly, during the fourth operation, work is spent in pushing the piston to an amount represented by the area A_3 A O N_3.

19. Hence the mechanical effect (represented by the area O A A_1 A_2 N_2) which was obtained during the first and second operations, exceeds the work (represented by N_2 A_2 A_3 A O) spent during the third and fourth, by an amount represented by the area of the quadrilateral figure AA_1 A_2 A_3; and, consequently, it only remains for us to evaluate this area, that may determine the total mechanical effect gained in a complete cycle of operations. Now, from experimental data, at present nearly complete, as will be explained below, we may determine the length of the line A A_1 for the given temperature S, and a given absorption H, of heat, during the first operation; and the length of A_2 A_3 for the given lower temperature T, and the evolution of the same quantity of heat during the fourth operation; and the curves A_1 PA_2, A_3 P' A may be drawn as graphical representations of actual observations. The figure being thus constructed, its area may be measured, and we are, therefore, in possession of a graphical method of determining the amount of mechanical effect to be obtained from any given thermal agency. As, however, it is merely the area of the figure which it is required to determine, it will not be necessary to be able to describe each of the curves A_1 P A_2 A_3 P' A, but it will be sufficient to know the difference of the abscissas corresponding to any equal ordinates in the two; and the following analytical method of completing the problem is the most convenient for leading to the actual numerical results.

Draw any line P P' parallel to O X, meeting the curvilineal sides of the quadrilateral in P and P'. Let § denote the length of this line, and p its distance from O X. The area of the figure, according to the integral calculus, will be denoted by the expression

$$\int_{p_3}^{p_1} \S d\, p,$$

where p_1, and p_3 (the limits of integration indicated according to FOURIER'S notation) denote the lines O A, and N_3 A_3, which represent respectively the pressures during the first and third operations. Now, by referring to the construction described above, we see that § is the difference of the volumes below the piston at corresponding instants of the second and fourth operations, or instants at which the saturated steam and the water in the cylinder have the same pressure p, and, consequently, the same temperature which we may denote by t. Again, throughout the second operation the entire contents of the cylinder possess a greater amount of heat by H units than during the fourth; and, therefore, at any instant of the second operation there is as much more steam as contains H units of latent heat, than at the corresponding instant of the fourth operation. Hence, if k denote the latent heat in a unit of saturated steam at the temperature t, the volume of the steam at the two corresponding instants must differ by $\frac{H}{k}$. Now, if δ denote the ratio of the density of the steam to that of the water, the volume $\frac{H}{k}$ of steam will be formed from the volume $\delta \frac{H}{k}$ of water; and, consequently, we have sulphurous acid, or carbonic acid under high pressure, which approaches the physical condition of a vapor at saturation; and therefore, in general, and especially in practical applications to real air-engines, it will be unnecessary to make any modification in the expressions. In cases where it may be necessary, there is no difficulty in making the modifications, when the requisite data are supplied by experiment.

Either the steam-engine or the air-engine, according to the arrangements described above, gives all the mechanical effect that can possibly be obtained from the thermal agency employed. For it is clear, that, in either case, the operations may be performed in the reverse order, with every thermal and mechanical effect reversed. Thus, in the steam-engine, we may commence by placing the cylinder on the impermeable stand, allow the piston to rise, performing work, to the position E_3 F_3; we may then place it on the body B, and allow it to rise, performing work, till it reaches E_2 F_2; after that the cylinder may be placed again on the impermeable stand, and the piston may be pushed down to E_1 F_1; and, lastly, the cylinder being removed to the body A, the piston may be pushed down to its primitive position. In this inverse cycle of operations, a certain amount of work has been spent, precisely equal, as we readily see, to the amount of mechanical effect gained in the direct cycle described above; and heat has been abstracted from B, and deposited in the body A, at a higher temperature, to an amount precisely equal to that which, in the direct cycle, was *let down* from A to B. Hence it is impossible to have an engine which will derive more mechanical effect from the same thermal agency, than is obtained by the arrangement described above; since, if there could be such an engine, it might be employed to perform, as a part of its whole work, the inverse cycle of operations, upon an engine of the kind we have considered, and thus to continually restore the heat from B to A, which has descended from A to B for working itself; so that we should have a complex engine, giving a residual amount of mechanical effect without any thermal agency, or alteration of materials, which is an impossibility in nature. The same reasoning is applicable to the air-engine; and we conclude, generally, that any two engines, constructed on the principles laid down above, whether steam-engines with different liquids, an air-engine and a steam-engine, or two air-engines with different gases, must derive the same amount of mechanical effect from the same thermal agency.